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U.S. PATENT APPLICATION

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Invention: EASY-FIT HEAT SCREENING DEVICE FOR CONNECTING A COOLING PIPE AND A THROUGH-HOLE FORMED IN A NOZZLE SUPPORT RING OF A GAS TURBINE

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SPECIFICATION

EASY-FIT HEAT SCREENING DEVICE FOR CONNECTING A COOLING
PIPE AND A THROUGH-HOLE FORMED IN A NOZZLE SUPPORT RING
OF A GAS TURBINE

5 The present invention refers to an easy-fit heat
screening device for connecting a cooling pipe and a
through-hole formed in a nozzle support ring of a gas
turbine.

 As is known, gas turbines are machines consisting
10 of a compressor and single or multiple-stage turbine,
where these components are connected together by a
rotating shaft and where a combustion chamber is
provided between the compressor and the turbine.

 In these machines, air from the external
15 environment is supplied to the compressor so as to
pressurise it.

 The pressurised air passes through a series of
pre-mixing chambers which terminate in a converging
portion and inside each of which an injector feeds the
20 fuel which is mixed with the air so as to form an
air/burning fuel mixture.

 The fuel is introduced inside the combustion
chamber and is ignited by means of suitable sparking
plugs so as to produce combustion which is aimed at

causing an increase in temperature and pressure and therefore enthalpy of the gas.

At the same time, the compressor supplies pressurised air which is made to pass both through the
5 burners and through the casing of the combustion chamber so that the abovementioned pressurised air is available for fuelling the combustion.

Then the high-temperature and high-pressure gas reaches, via suitable ducts, the different stages of
10 the turbine which converts the enthalpy of the gas into mechanical energy which is available to the user.

It is known, moreover, that in order to achieve the maximum efficiency of a given gas turbine it is necessary for the temperature of the gas to be as high
15 as possible; however, the maximum temperature values which can be reached during use of the turbine are limited by the strength of the materials used.

Furthermore, in gas turbines, as in other turbine machines, it is necessary to prevent these hot gases
20 from being drawn into spaces which are situated around the impellers of the said turbines.

It is therefore necessary to pressurise suitably the cavities which are adjacent to the fluid path so as to prevent a reduction in the efficiency and

excessively high operating temperatures of the turbine impellers.

In the known art, cooling pipes are used for this purpose, said pipes conveying a cooling air which is
5 supplied from the compressor and having, for example, to pass through the nozzles of the first low-pressure stage (which are thus provided with suitable holes) and through the nozzle support ring, in order to reach the zones to be pressurised.

10 In particular, the air which is tapped from the compressor has a temperature which is considerably lower than the operating temperature of the nozzle support ring. In order to avoid - in the zones where the cooling pipes pass through a through-hole formed in
15 the nozzle support ring - the spread of high temperatures inside the said support ring, heat screening devices have been introduced.

These devices are arranged between the cooling pipe and the through-hole of the nozzle support ring
20 and comprise a tubular structure.

It is pointed out, moreover, that these tubular structures also perform another function. In fact they act as a seat for the cooling pipe and ensure a sealed connection with the through-hole formed in the nozzle

support ring.

The cooling pipe, which generally has spherical ends, departs from an external casing of the turbine and terminates inside the through-hole of the nozzle
5 support ring.

In some types of gas turbine, the seat for the spherical end of the cooling pipe is provided by a bush inserted from the outside of the nozzle support ring and locked with a ring nut on the inside of the ring
10 itself. This is possible when the through-holes passing through the nozzle support ring are straight, there being only one zone where pressurisation is to be performed.

In gas turbines, however, where there are two
15 zones to be supplied, the through-holes passing through the nozzle support ring are of two types: one which is straight and the other inclined. In this case, in the prior art, two different types of fixing devices are used, one for straight holes and one for inclined
20 holes, using also two different fixing methods.

The object of the present invention is therefore that of overcoming the abovementioned drawbacks and in particular that of providing an easy-fit heat screening device for connecting a cooling pipe and a through-hole

formed in a nozzle support ring of a gas turbine which can be applied equally well to straight holes and inclined holes.

Another object of the present invention is that of
5 providing an easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in an nozzle support ring of a gas turbine which allows a reduction in production and maintenance costs compared to the prior art.

10 Another object of the present invention is that of providing an easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in a nozzle support ring of a gas turbine which is particularly reliable, simple and functional.

15 These and other objects according to the present invention are achieved by providing an easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in a nozzle support ring of a gas turbine as described in Claim 1.

20 Further characteristic features are described in the claims which follow.

The characteristic features and advantages of an easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in a nozzle support ring

of a gas turbine according to the present invention will emerge more clearly and fully from the following description provided by way of a non-limiting example with reference to the accompanying schematic drawings
5 in which:

Figure 1 is a cut-away side elevation view of a connection between a cooling pipe and a straight through-hole formed in a nozzle support ring of a gas turbine, with a heat screening device according to the
10 prior art inserted therein;

Figure 2 shows a sectioned side elevation view of a connection between a cooling pipe and a through-hole, having two inclined sections formed in a nozzle support ring of a gas turbine, in one section there being
15 inserted an easy-fit heat screening device according to the present invention;

Figure 3 shows a sectioned side elevation view of a connection between a cooling pipe and a straight through-hole formed in a nozzle support ring of a gas
20 turbine, where a system for fixing a heat screening device according to the present invention using a mounting tool is shown;

Figure 4 shows an enlarged view of Figure 3 illustrating a top end of the heat screening device

according to the present invention, after use of a mounting tool;

Figure 5 shows an enlarged view of Figure 3 illustrating a top end of the heat screening device according to the present invention, before use of a mounting tool.

With reference to Figure 1, a heat screening device according to the prior art is indicated overall by 10, said device being intended to join together a cooling pipe 12 and straight through-hole 14 formed in a nozzle support ring 16 of a gas turbine.

In the example according to Figure 1, the screening device 10 comprises a tubular structure 18 having a top end 20 with an external diameter approximately equal to an internal diameter of the through-hole 14.

This tubular structure 18 is inserted from the outside of the nozzle support ring 16 and is arranged at a bottom end of the through-hole 14, being locked there by a ring nut 22 mounted on the inside of the said ring 16 so as to support the overlying tubular structure 18.

A bottom - generally spherical - end of the cooling pipe 12 extends inside the tubular structure

18.

Figures 2, 3, 4 and 5 illustrate an easy-fit heat screening device 110, according to the present invention, for connecting a cooling pipe 112 and a through-hole 114 formed in a nozzle support ring 116 of a gas turbine, where components identical/or equivalent to those illustrated in Figure 1 have the same reference numbers increased of 100.

More precisely, Figure 2 shows a through-hole 114 having two sections inclined with respect to each other, whereas Figure 3 shows a straight through-hole 114.

In both cases and as can be clearly seen in Figure 5, an upper zone of the through-hole 114 has a groove 130. The groove 130 is defined at the bottom by a first flat surface 132 which is substantially perpendicular to the axis of this upper zone and at the top by a second flat surface 134 having an inclination along a line directed towards an outer extension of the first surface 132.

The upper zone of the through-hole 114 has, above the groove 130, a first internal diameter greater than a second internal diameter provided underneath the said groove 130.

The screening device 110 comprises a tubular structure 118. This tubular structure 118 is inserted from the outside of the nozzle support ring 116 and is arranged inside the through-hole 114.

5 The tubular structure 118 has at the bottom an annular end 124 with an external diameter which is approximately equal to the second internal diameter of the through-hole 114.

At the top, the tubular structure 118 has a shaped
10 annular end 126.

As can be clearly seen in Figure 5, an external surface of the shaped annular end 126 is formed with two different diameters. At the top a first external cylindrical surface 128 is provided, said surface
15 having a diameter slightly smaller than the first internal diameter of the through-hole 114. At the bottom there is a second external cylindrical surface 129, with a diameter slightly smaller than the second internal diameter of the through-hole 114.

20 The first external cylindrical surface 128 is joined to the second external cylindrical surface 129 by a flat annular surface 127 which extends substantially perpendicularly with respect to the axis of the upper zone of the through-hole 114.

Finally, the shaped annular end 126 terminates at the top in a flat surface 125, having an inclination along a line directed towards an outer extension of the flat annular surface 127.

5 A bottom - generally spherical - end of the cooling pipe 112 extends inside the tubular structure 118.

The operating principle of the easy-fit heat screening device 110 for connecting a cooling pipe 112
10 and a through-hole 114 formed in a nozzle support ring 116 of a gas turbine, according to the present invention, is clear from that described above with reference to the figures and briefly is as follows.

The heat screening device 110 is inserted, from
15 outside of the nozzle support ring 116, into the upper zone of the through-hole 114. Insertion is performed so that the flat annular surface 127 mates with the first flat surface 132 of the groove 130.

At this point, in order to lock the heat screening
20 device 110 inside the through-hole 114, the shaped annular end 126 is engaged inside the groove 130.

More precisely, the shaped annular end 126 is bent, as can be seen in Figure 3, using for example a mounting tool with a conical end which is inserted from

the outside of the nozzle support ring 116.

After this operation, as shown in Figure 4, the shaped annular end 126 enters partly inside the groove 130; in particular, the flat surface 125 of the shaped annular end 126 engages in an interfering manner with part of the second flat surface 134.

It is clear that the first external cylindrical surface 128 is designed with dimensions suitable for this purpose: the inclination of the second flat surface 134 is also approximately parallel to the inclination of the flat surface 125 of the shaped annular end 126 such that, after bending of the shaped annular end 126, the flat surface 125 makes firm contact with the second flat surface 134.

The heat screening device 110 advantageously uses an oil-hydraulic apparatus equipped with the conical-end mounting tool and able to generate a thrust, for example, of 10,000 Newton.

It should be noted how, in order to lock the device 110, it is necessary to act exclusively on the outside of the nozzle support ring 116.

It must also be pointed out how the material from which the heat screening device 110 according to the invention is made must have, in addition to heat

resistance characteristics, also good plastic deformation properties required for bending of the shaped annular end 126.

The description provided clearly illustrates the
5 characteristic features of the easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in a nozzle support ring of a gas turbine according to the present invention, as well as the advantages associated therewith, including:

- 10 - simple installation and maintenance;
- reliability;
- lower costs, compared to the prior art, since there is a single heat screening device suitable for both a straight cooling pipe and a pipe with two
15 sections inclined relative to each other: the reduction in the costs arises from the fact that use of the device according to the invention, although it requires a special tool, is industrially more simple than the
prior art where it was required to perform a final
20 safety spot weld.

Finally, it is clear that the easy-fit heat screening device for connecting a cooling pipe and a through-hole formed in a nozzle support ring of a gas turbine thus conceived may be subject to numerous

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modifications and variants, all of which fall within
the scope of the invention; moreover, all the details
may be replaced by technically equivalent elements. In
practice the materials used, as well as the forms and
5 the dimensions may be of any nature according to the
technical requirements.

The scope of protection is therefore defined by
the accompanying claims.